Improving Order Picking Efficiency by Analyzing the Combination of Storage, Batching, Zoning, and Routing Policies in a 2-Block Warehouse

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As customer markets globalize, supply chains are increasingly depending on efficient and effective logistic systems in order to distribute products in a large geographical area. Warehouses are an important part of supply chains, and therefore warehouse operations need to work in an efficient and effective way. Warehouse operations can be classified into four categories, including receiving, storage, order picking, and shipping [2].

In order to differentiate from competitors in terms of customer service, warehouses accept late orders from customers while providing delivery in a quick and timely way. By accepting late orders, the remaining time to pick an order is reduced. Furthermore, the order behavior of customers has changed from ordering few and large orders to many orders consisting of only a limited number of order lines. The changed order behavior can be ascribed to upcoming e-commerce markets and forces warehouses to handle a larger number of orders, while order picking time has shortened. Therefore, order picking management, in particular efficiently and effectively organizing order picking operations, has been identified as an important and complex activity [1].

One way to obtain a more efficient order picking process is to allocate fast moving products to storage locations closely located to the depot, rather than randomly assigning stock keeping units (SKUs) to storage locations. Storage location assignment policies define rules to assign SKUs to individual storage locations in order to minimize the order picker travel distance. As traveling in a warehouse is often the dominant factor in order picker's activities, a travel distance reduction will contribute to a more efficient order picking process [5].

Furthermore, batch picking, instead of picking each order separately, allows warehouses to handle a larger number of orders in shorter time windows. By picking multiple orders in a single picking tour, the order picker travel distance per order will be reduced. The order batching problem is concerned with deciding on the rules defining which orders to combine in a picking tour in order to minimize the order picker travel distance [1] [3].

Another practice of moving to a more efficient order picking process is dividing a warehouse into different smaller areas, being order picking zones. Each order

picker is assigned to a single zone and is responsible for picking all SKUs of an order belonging to this zone. As a consequence each order picker travels in a pre-specified part of the warehouse and thus travel distance will be reduced [1].

Finally, shorter order picking routes contribute to a more efficient order picking process. Given a pick list with a number of storage locations to visit, routing policies determine the sequence in which the SKUs on the pick list are to be retrieved, with the aim of composing short order picking routes [4].

While the number of publications dealing with one specific warehouse operation area is extensive, only a limited number of researchers examine different warehouse processes simultaneously, even though the efficiency of different warehouse policies is interdependent [2]. Especially the effect of zoning in combination with other order picking decisions, such as storage, routing and batching, has received little research attention. This research focuses on several decisions related to order picking activities. A real-life case study demonstrates the value of studying the combined effect of storage, order batching, zoning, and routing policies in order to minimize the distance traveled by order pickers.

The objective of this research is to evaluate several storage, batching, zoning, and routing policies simultaneously in order to reduce the order picker travel distance, resulting in a more efficient order picking process. In the simulation experiment of this paper five different storage location assignment policies, two different batching algorithms, strict order picking and zone picking, and five different routing heuristics are analyzed. The zone picking experiment is further analyzed by changing the number of order picking zones as well as the storage zone assignment policy.

The main contribution of this research is a real-life case study on how order picking activities may be improved by analyzing different storage, order batching, zoning, and routing policies simultaneously. Furthermore, a multilevel regression provides insight into the impact of each individual order picking policy on the distance traveled by order pickers, as well as interactions between storage, batching, zoning and routing policies.

Références

[1] De Koster, R., Le-Duc, T., Roodbergen, K.J., 2007. Design and Control of Warehouse Order Picking : A Literature Review. Eur. J. Oper. Res. 182, 481-501.

[2] Gu, J., Goetschalckx, M., McGinnis, L.F., 2007. Research on Warehouse Operation : A Comprehensive Review. Eur. J. Oper. Res. 177, 1-21.

[3] Henn, S., Koch, S., Wäscher, G., 2012. Order Batching in Order Picking Warehouses : A Survey of Solution Approaches, in : Manzini, R. (Ed.), Warehousing in the Global Supply Chain. Springer London, pp. 105-137.

[4] Petersen, C.G., Schmenner, R.W., 1999. An Evaluation of Routing and Volume-based Storage Policies in an Order Picking Operation. Dec. Sci. 30, 481-501.

[5] Roodbergen, K.J., 2012. Storage Assignment for Order Picking in Multiple-Block Warehouses, in : Manzini, R. (Ed.), Warehousing in the Global Supply Chain. Springer London, 139-155.